Royal Netherlands
Meteorological Institute
Ministry of Transport, Public Works and Water Management

OMI
Data Processing

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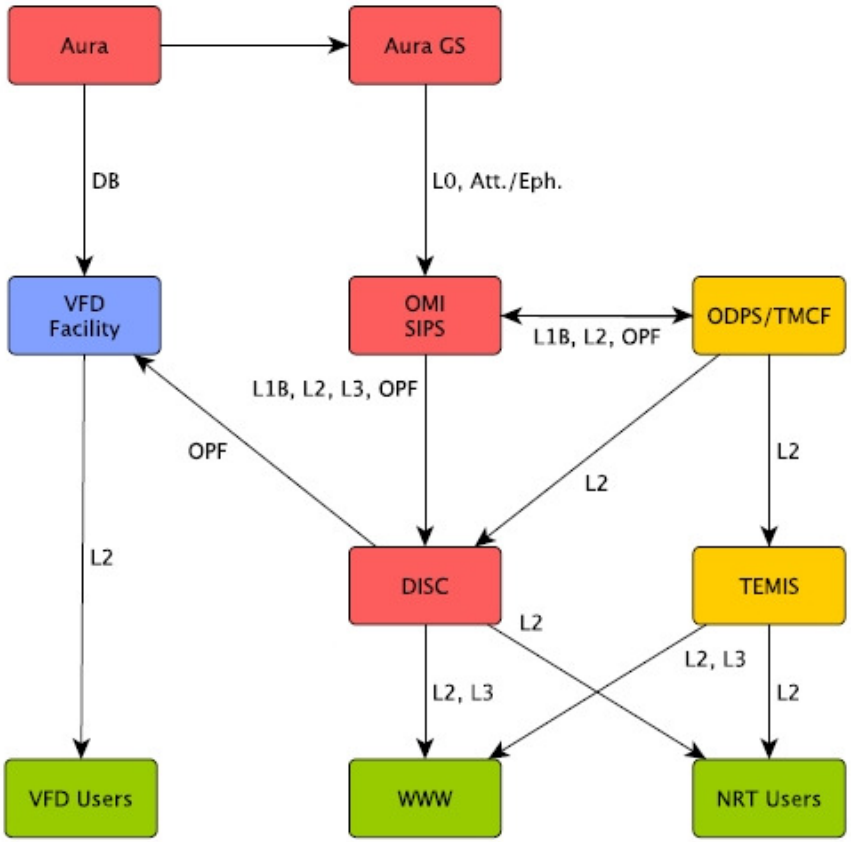
Content of presentation

1. Dataprocessing: system overview
2. Dataprocessing: status
3. Data products
4. Impact row anomaly on dataprocessing

Data processing overview



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- L1b processing on OSIPS
- L2 processing on OSIPS and ODPS
- Data distribution via DISC and TEMIS

ODPS = OMI Data Processing System @ KNMI

TMCF = Trend Monitoring Calibration Facility @ KNMI

OPF = Operational Parameter File
(needed for L0->L1b processing)

TEMIS = Tropospheric Emission
Monitoring Internet Service @ KNMI

Data processing status

- Processing (L1b and L2) is very stable
- Current version of L0->L1b processor:
  - 1.1.3 for forward and NRT data stream
  - 1.1.2 for VFD data stream (Direct Broadcast in Finland)
- OMI SIPS forward data publ. available on DISC (Collection 3)
  http://disc.gsfc.nasa.gov/ (all L1b and L2 data products)
- OMI SIPS NRT data publicly available via the Lance portal
  http://lance.nasa.gov/ (currently 4 L2/L3 data products)
- No reprocessing for Collection 4 planned yet

Data products (1/2)

Product Name	L1 Accuracy Rqmt Abs::Rel	Achievement	Basis	
Radiances	3%::1%	2%::0.5%	Other satellite instruments	
Total Ozone	3%::1.5%	2%::0.5% @SZA<75°	Dobson/Brewer	
Ozone Profile	10%::10%	10%::5%	MLS, SBUV/2	
Tropospheric Column Ozone	25%::10%	20%::5% in tropics 25%::10% in mid lat	Ozonesonde	
Surface UVB Flux	10%::10%	2%::1% in cloud-free non-polluted areas 30%::5% elsewhere	Surface obs	
Cloud Scattering Layer Pressure	100hPa::30hPa	50hPa::10 hPa for cloud radiance fraction >50%	MODIS, Cloudsat	
Aerosol Optical Thickness	0.1::0.05 30%::10%	20%::5% for elevated smoke or dust	Aeronet, MODIS, MISR	
Aerosol Single Scattering Albedo	0.1::0.05	0.03::0.01 for elevated smoke or dust	Aeronet	

Data products (2/2)

Product Name	L1 Accuracy Rqmt Abs::Rel	Achievement	Basis	
SO_2	$3x10^{16}$ (50%)::$2x10^{16}$ (20%) non-volcanic 30%::20% volcanic	$2x10^{16}$::$1x10^{16}$ polluted 5%::1% volcanic	Model, ground obs	
NO_2	$2x10^{14}$::$2x10^{14}$ background 30%::20% polluted	$5x10^{14}$::$2x10^{14}$ background 20%::10% polluted	Model, ground obs, aircraft data	
HCHO	35%::25%	TBD	Model	?
BrO	25%::25%	TBD	Model, ground obs	?
OClO	15%::10%	No information	No information	?

*On top of the above listed data products also **glyoxal** and the **spectral surface reflectance** were derived from OMI*

Row Anomaly: introduction

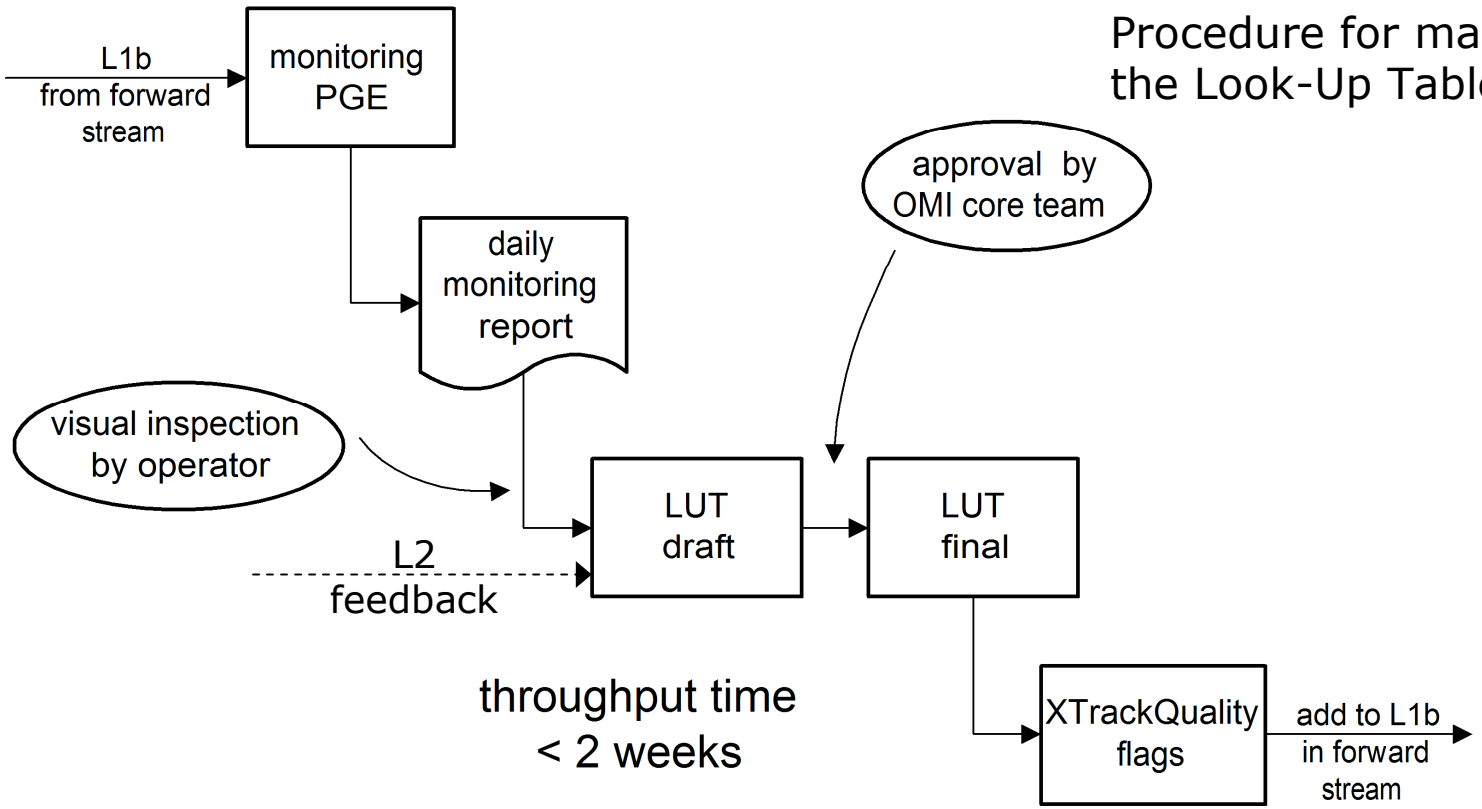
- A so-called row anomaly affects the L1b data
- Presumably caused by external material in the OMI nadir fov
- Blocks light from Earth causing multiplicative error
- Reflects light from outside nadir fov from both Earth and Sun causing additive errors
- Inhomogeneous slit illumination causing wavelength shift
- Currently, 50 % of the fov is affected

Row Anomaly: approach

- Monitor anomaly using automated tools*
- Flag the affected rows in the L1b radiance data*
- Correct for the wavelength shift*
- Develop correction algorithms for the multiplicative and additive errors (see poster by Remco Braak)

* Already implemented in the L1b forward stream

Row anomaly: monitoring and flagging

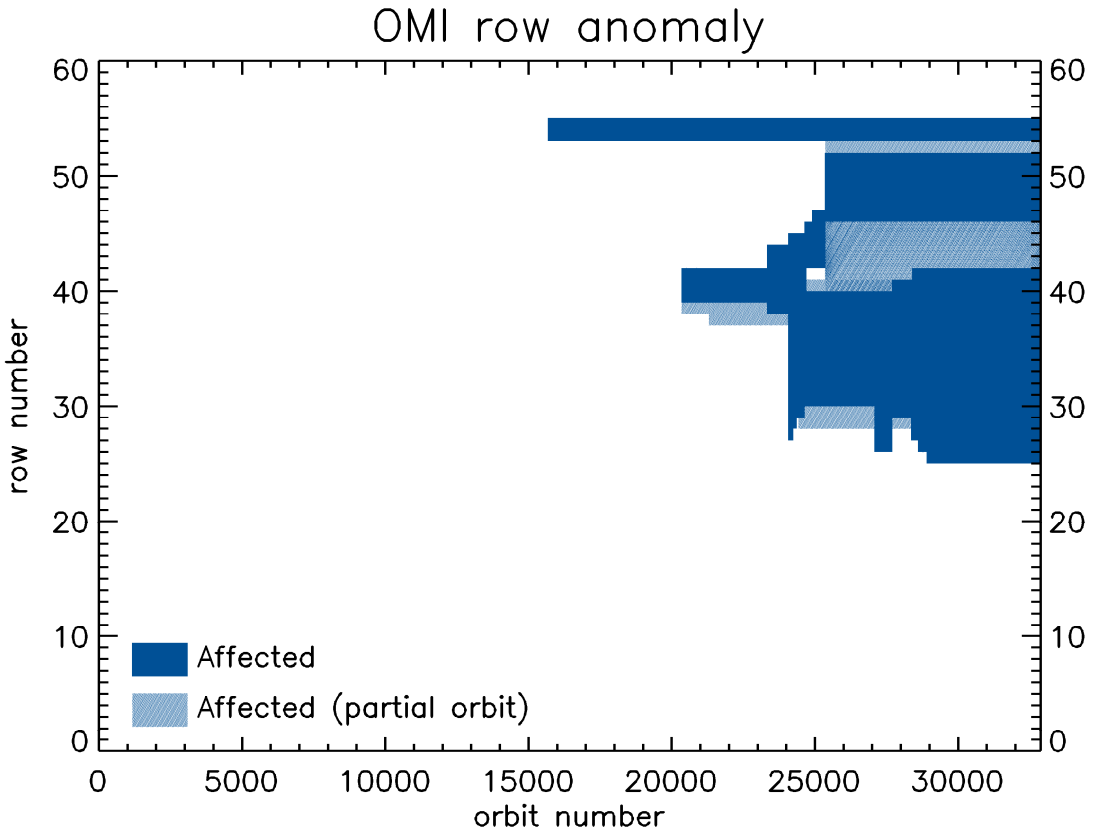


Row anomaly: flagging L1b data

Bit	Description (LSB = bit 0)
0-2	Row anomaly correction flags: 0 = Not affected 1 = Affected, Not corrected, do not use 2 = (Slight) affected, not corrected, use with caution 3 = Affected, corrected, use with caution. 4 = Affected, corrected, use pixel. 5-6 = Not used 7 = Error during processing.
3	Reserved for future use.
4	Possibly affected by wavelength shift
5	Possibly affected by blockage
6	Possibly affected by stray sunlight
7	Possibly affected by stray earthshine

XTrackQualityFlags definition

Row anomaly: example of monitoring output



Evolution of the row anomaly in UV1 and VIS

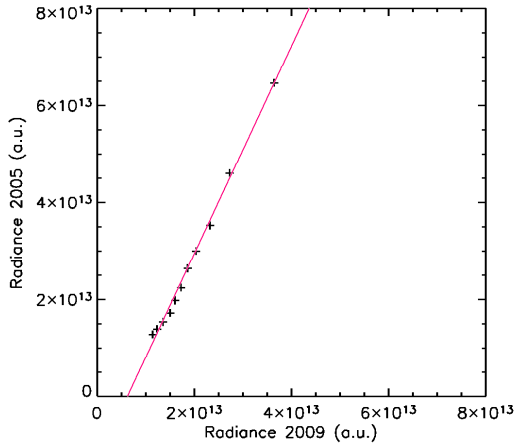
Row anomaly: correcting L1b data

- A correction algorithm has been implemented in a test version of the L0 -> L1b software:

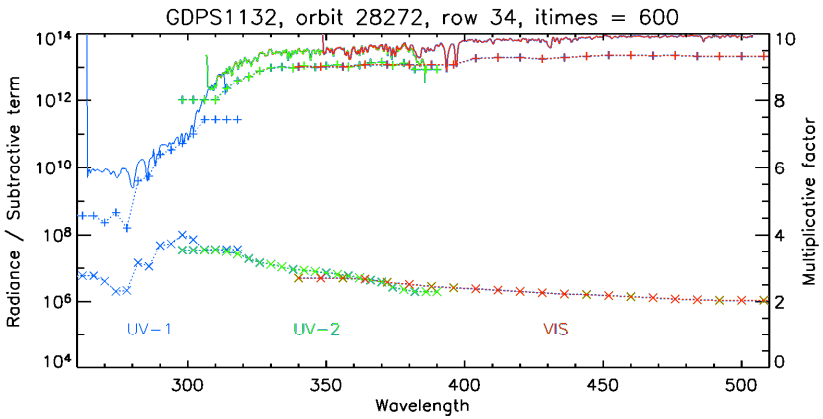
$$R_{\mathrm{corr}}(c,\varphi,r,\lambda) = m(c,\varphi,r,\lambda)\cdot R_{\mathrm{orig}}(c,\varphi,r,\lambda) + a(c,\varphi,r,\lambda)$$

R=radiance, c=channel (UV1,UV2,VIS), φ=orbit phase, r=row number, λ= wavelength

- m and a are determined by fitting a straight line to one week of last weeks radiance data and that of the corresponding week in 2005

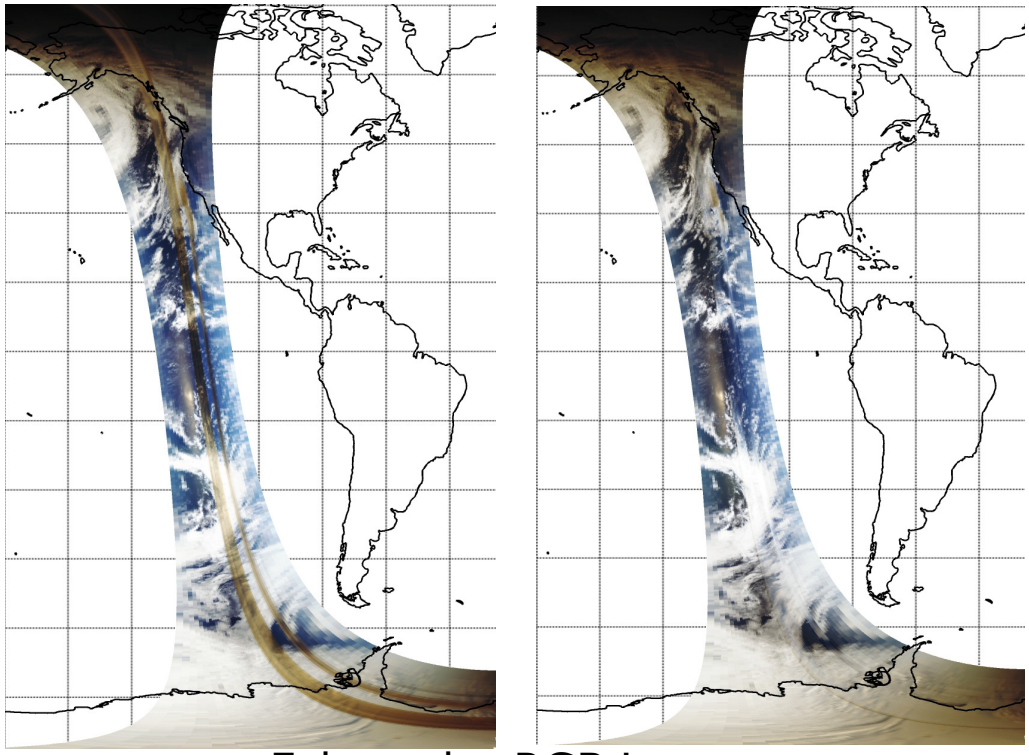


Row anomaly: correcting L1b data



Solid line: corrected spectrum

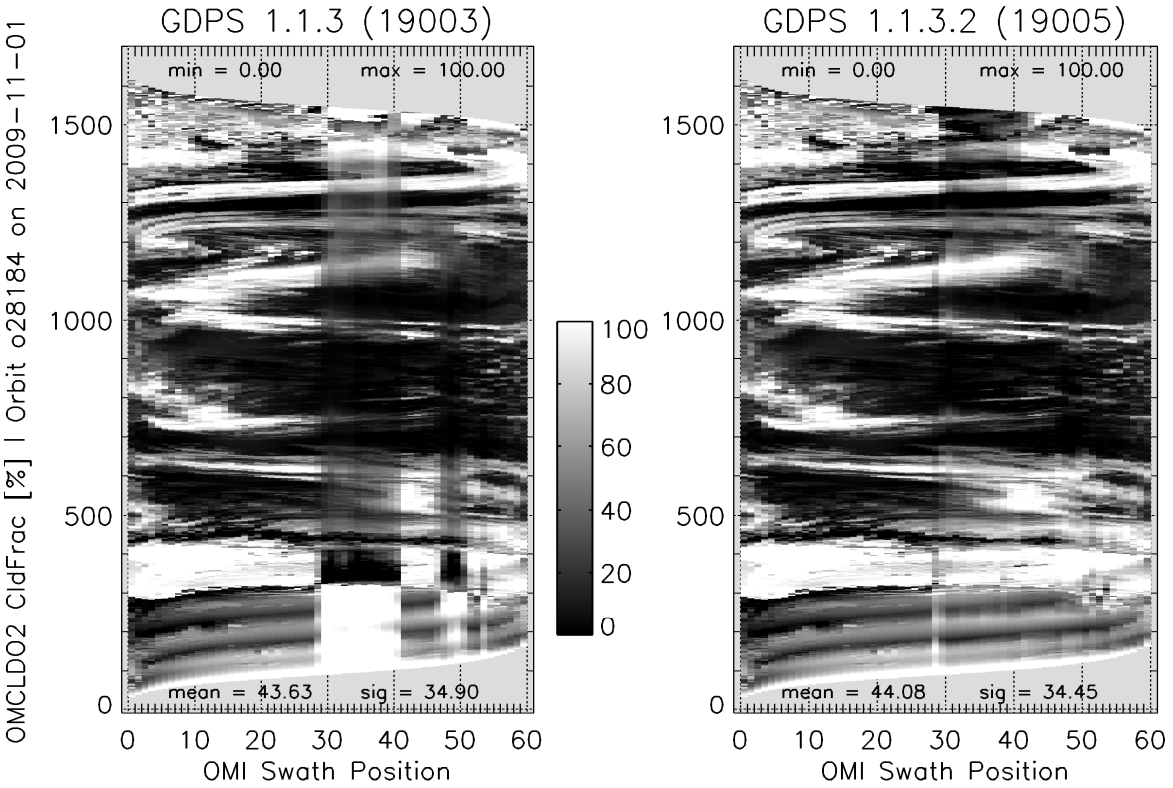
Dashed lines: m(x) and –a(+)



False color RGB image

Uncorrected L1b Corrected L1b

Row anomaly: corrected L2 data



OMCLDO2 cloud fraction

using uncorrected L1b using corrected L1b

Row anomaly: post- and reprocessing

- L1b data will be postprocessed soon to add the XTrackQualityFlags field and WavelengthFit fields in the existing L1b data.
  So, only information about the row anomaly will be added but no correction will be performed.

- L1b data will only be reprocessed (using correction algorithm in L0->L1b software) if the science quality of the data can be significantly improved.
  No date for reprocessing has been set yet.

Conclusion

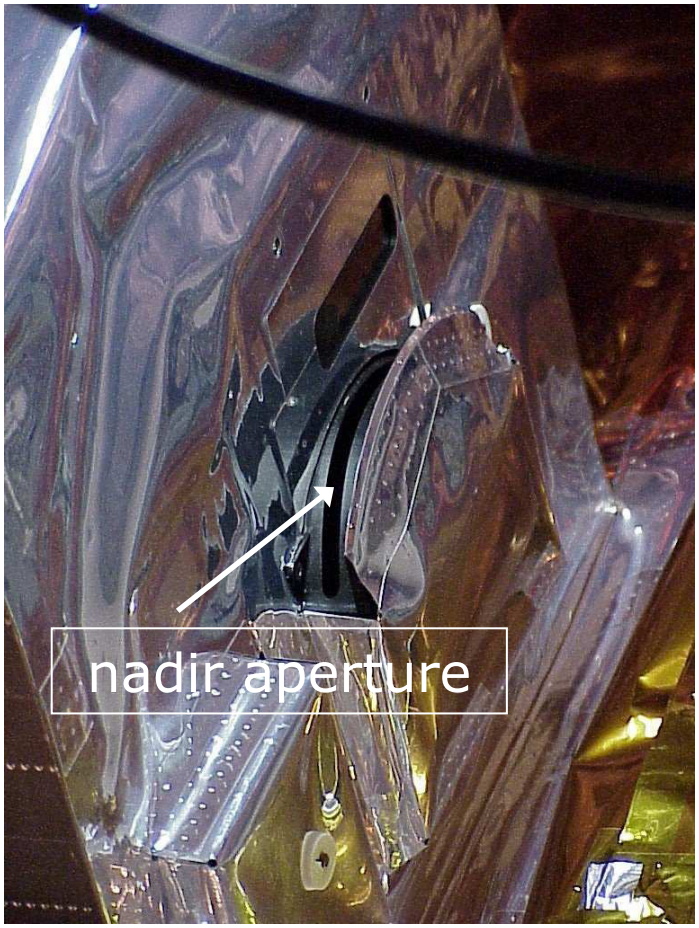
- Status of OMI dataprocessing is very good and stable
- Decision on the next L1b reprocessing will depend on results of the row anomaly correction work

Backup slides

The row anomaly and archive sets on OSIPS

GDPS	Remark	Time	Archive Set
1.1.3	OPS environment L1b not corrected	≥ 1 Feb 2010 / orbit 29515	10003 forward
			19003 Nov 2009
1.1.3.1	Test environment L1b corrected for blockage	≥ 6 Apr 2010 / orbit 30447	19993 forward
			19004 Nov 2009
1.1.3.2	Test environment L1b corrected for blockage + 0th-order earthlight	≥ 19 Aug 2010 / orbit 32417	19993 forward
			19005 Nov 2009

Introduction row anomaly

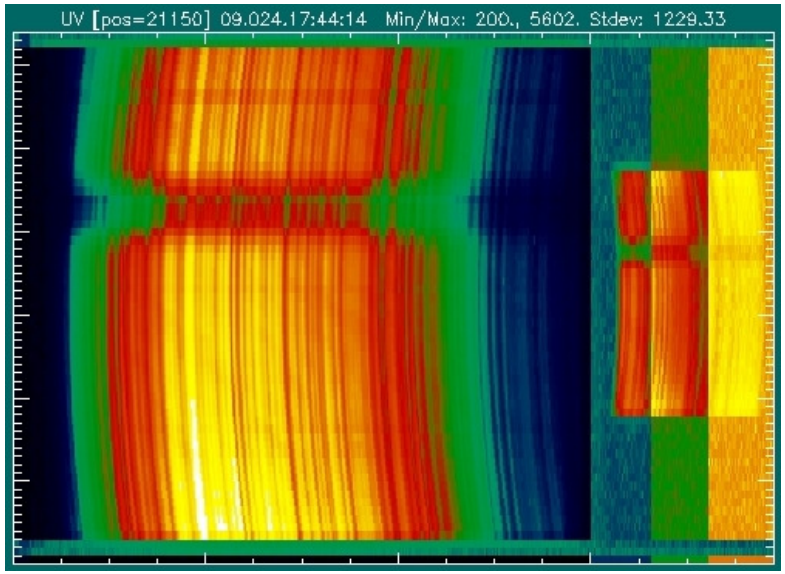


- The cause of the row anomaly is still not well understood.
- The most likely explanation is that something outside the instrument (e.g. MLI from the instrument) is blocking part of the nadir fov / reflecting light into the nadir fov.

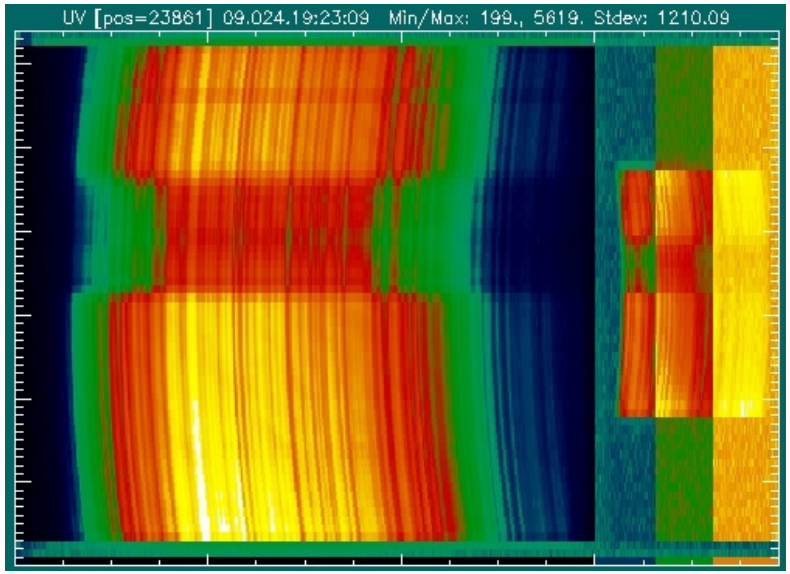
OMI Optical Bench

Introduction row anomaly

24jan09/orbit 24092



24jan09/orbit 24093



X-track

OMI L0 UV CCD images

wavelength

Errors caused by row anomaly

- **A multiplicative error**:
  Caused by the partial blockage of the nadir field of view resulting in reduced radiance levels.

- **A wavelength shift**:
  Caused by inhomogeneous illumination of the spectral slit due to the blocking material, resulting in a change of the slit function.

- **Stray earthlight related additive error**:
  Caused by earthlight, reflected by the blocking material from outside the OMI fov into the nadir port.

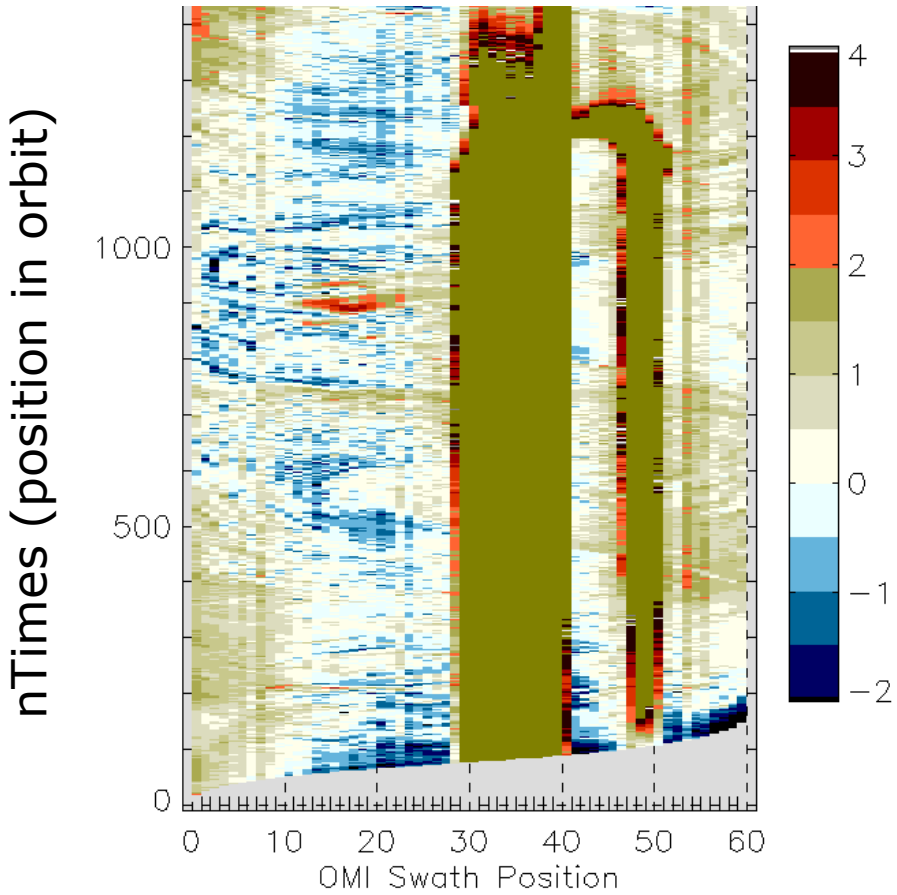
- **Stray sunlight related additive error**:
  Caused by sunlight, reflected by the blocking material into the nadir port for part of the orbit.

Flagging the row anomaly

Row #	Channel(s)	Orbit #	Orbit phase	Effects
25	UV-2/VIS	≥ 28900	all	Blockage/wavelength shift
26,27	UV-2/VIS	≥ 28750	0.58-1	Stray sunlight
41	UV-2	≥ 28400	all	Blockage/wavelength shift
50	UV-2/VIS	≥ 25350	all	Stray earthlight
51	UV-2	≥ 25350	all	Blockage/wavelength shift
51,52	UV-2/VIS	≥ 25364	0.58-1	Blockage/wavelength shift/ stray earthlight
41-52	UV-2	≥ 25364	0.58-1	Stray sunlight
23-26	UV-1	≥ 25364	0.58-1	Stray sunlight

Recent proposal for LUT update

Flagging the row anomaly



Example of L2 feedback:

OMAERO UV Index
Nov 1st 2009, orbit 28175

Post-processing L1b data

- Orbit 31366 (June 8, 2010) and later:
  - All L1b data (will) have an up-to-date XTrackQualityFlags field.
  - If row anomaly changes, XTrackQualityFlags will be updated in the L1b forward stream.
- For all earlier orbits:
  - L1b data will be post-processed once, adding or updating XtrackQualityFlags with correct values.
  - In case more insight becomes available about past row anomaly behaviour, XTrackQualityFlags will be updated only as part of the next L1b reprocessing campaign.

Flagging and GDPS versions

GDPS (L0->L1b processing S/W)			XtrackQualityFlags
Version	Period	Remarks	
≤1.1.1	≤Oct 08, 2008		No
1.1.2	Oct 08, 2008 – Feb 1, 2010		Yes, but static (one set of values for whole period)
1.1.3 (current version)	≥Feb 1, 2010	New fields added to L1b: • WavelengthFitCoefficient • WavelengthFitCoefficientPrecision • WavelengthFitChiSquare • WavelengthFitFlags • OrbitPhase field Improved noise calculation	Yes, dynamically filled. LUT version 1: Feb 1, 2010 LUT version 2: March 20, 2010 LUT version 3: June 8, 2010

Update your L2 PGE's to incorporate the new fields!!!!

Flagging and GDPS versions

GDPS			XtrackQualityFlags
Version	Period	Remarks	
≤1.1.1	≤Oct 08, 2008		No
1.1.2	Oct 08, 2008 – Feb 1, 2010		Yes, but static (one set of values for whole period)
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L1b data will be post-processed

LUT versions

Version	Orbit Range	Period
	– 29514	– 1 Feb 2010
1	29515 – 30201	1 Feb – 20 Mar 2010
2	30202 – 31365	20 Mar – 8 Jun 2010
3	31366 –	8 Jun –